CASE STUDY

Special Funding Seeds Early E85 Vehicle Purchases and Infrastructure Development in Minnesota

Energy Policy Act (EPACT) mandates for state purchases of alternative-fuel vehicles (AFVs) were scheduled to begin in 1997, but Minnesota got an early start on meeting these requirements. In 1993, each of six Midwestern states, including Minnesota, received a $60,000 grant from the Council of Great Lakes Governors Biomass Program to purchase ethanol-fueled vehicles. Ethanol, an alcohol produced from grain, is used to make E85, a blend of 85% ethanol and 15% gasoline used as a vehicle fuel.

Early Purchase

Minnesota used the grant to pay for the incremental cost (the difference between the cost of an AFV and that of a conventional vehicle) of 10 flexible-fuel vehicles (FFVs) and the cost of the first E85 fuel pump. The pump was installed at an existing fueling facility at the main motor pool depot in St. Paul. Mike Roelofs, Manager of Energy Programs, Minnesota Department of Public Service, explained, "Once we had the fueling capabilities and car experience, expansion in the E85 area was the most cost-effective approach to building credits toward EPACT mandates."

The State of Minnesota now owns 76 E85 FFVs, most of which were acquired from dealers representing original equipment manufacturers. At first, the FFVs were assigned to state agencies that were willing to test the new vehicles, such as the Transportation and Public Service Departments. Later, FFVs were purchased for the Minnesota Department of Agriculture, while others were put into the state's daily rental pool, accessible to all other agencies. In 1994, Minnesota

used oil overcharge funds to provide grants to four cities – Fergus Falls, Mankato, Marshall, and Rochester. These grants supplied each city with four FFVs and an E85 fuel pump. Most recently, the state has been targeting agencies with offices in or near the four municipal areas to keep those fueling locations active.

Together with the state facility in St. Paul, the four municipal facilities form the nucleus of a regional network of fueling sites that supports the state's E85 vehicle fleet. No fueling site is more than 150 miles from another. The 150-mile radius is well within the range of the FFVs, so refueling is simple. However, an FFV can burn both E85 and gasoline, which allows the vehicles to be operated anywhere in the state, even where E85 is not available.

A Motivating Kernel

The growing E85 fueling infrastructure seems to be encouraging federal agencies in Minnesota to meet some of their EPACT mandates with E85-fueled FFVs. The General Services Administration has purchased 159 E85 sedans for federal offices in Minnesota, many of which are located in the Minneapolis/ St. Paul metropolitan area. And, on the basis of anticipated demand, the private sector plans to install E85 pumps at nine refueling stations statewide, including three in the Minneapolis/ St. Paul area.

Rebates and Resale

For each of its first 10 E85 vehicles, Minnesota paid an incremental price of $800-900. Recent manufacturer rebates have offset the incremental price either partly or completely. In fact, Ford now offers its FFV Taurus at a lower price than the gasoline version.

Minnesota usually sells state fleet cars after they accumulate about 75,000 miles. The resale value of FFVs is expected to be as high as that of conventional vehicles because the FFVs can also run on gasoline without modifications. However, as none of the FFVs has reached 75,000 miles and been released for resale yet, this expectation has not been tested.

Driver Acceptance and Concerns

According to Roelofs, new FFV drivers don't receive any special training, and they don't have to learn a new way to fuel their vehicles – E85 is filled from the same type of fuel pump as gasoline. Overall driver acceptance has been good. Most believe the FFVs perform identically to gasoline vehicles.

Some drivers were concerned about the range of the 1993 Chevrolet Lumina and the 1995 Ford Taurus (both of which have 16-gallon tanks). E85 contains about 20% less energy per gallon than gasoline, so the vehicle range is a bit shorter when driving on E85 as compared with gasoline. The 1996 Ford Taurus has an 18-gallon tank and thus a longer range.

Cold Weather Modifications

Drivers encountered problems when temperatures fell below freezing. Ethanol fuel vaporizes less readily than gasoline and tends to form droplets inside the cylinders in cold weather. The droplets conduct electricity and may bridge spark plug gaps, preventing the FFV from starting. Initially, Minnesota solved this problem by reducing the fuel's alcohol content by alternate filling, but this procedure was inconvenient and unreliable. The American Automobile Manufacturers Association now recommends using E70 fuel during winter months. The Minnesota fleet will use this fuel in the future, which should minimize cold weather problems.

Engine heaters are standard equipment on E85 FFVs; they solve most of the cold weather problems associated with the fuel. The heaters need to be plugged in when the vehicles are left outside, however, and the state motor pool parking lot does not have outdoor receptacles.

Vehicle Maintenance and the High Cost of Oil

Minnesota's main motor pool maintains most of the state's vehicles, including FFVs. Mechanics are certified to the same standards as those in a dealership and are therefore qualified to perform warranty services. According to Roelofs, mechanics require very little extra training to work on FFVs. The mechanics have not noticed any special maintenance problems that can be attributed to the use of E85, even after 50,000 miles per FFV.

Mechanics change the oil in the FFVs every 3,000 miles, just as they do for gasoline-powered vehicles. But special, more expensive mineral-based oils are needed to meet warranty requirements.

Fleet Facts

Fleet Type:	State government
Fleet Size:	4,500, of which 90 are AFVs
Alternative Fuels:	E85 (85% ethanol), propane, compressed natural gas (CNG)
Vehicles:	76 E85 flexible fuel sedans – Ford Taurus and Chevrolet Lumina; 10 propane pickup trucks and vans; 5 CNG sedans and vans

Minnesota purchases conventional oil in bulk for 65¢ per quart, but the synthetic oils range from $2.20 per quart for the Chevrolet Lumina to $9.00 per quart for manufacturer-specified oil for the Ford Taurus. The state is negotiating with Ford to use another brand of synthetic oil that is virtually identical to the Ford brand, but costs only $3.00-4.00 per quart. The 1996 Ford FFV also requires a special fuel filter that costs more than a conventional filter. However, these extra costs are insignificant when considered on a per-mile basis (see the economic analysis).

State of Minnesota E85 V ehicles

1993 Chevrolet Lumina:	30, driving 15,000-40,000 miles per year
1995 Ford Taurus:	7, driving 10,000-20,000 miles per year
1996 Ford Taurus:	39, no annual mileage accumulation available yet

Fuel Costs and Tax Credits

Although the Minnesota state fleet is exempt from federal excise tax on fuel, higher fuel costs do increase the incremental cost of running FFVs. Minnesota pays wholesale prices of about $1.30 per gallon for E85 (after the tax exemption) and about $0.95 for gallon for gasoline. Because E85 contains about 20% less energy per gallon than gasoline, the effective price for E85 is about $1.63 per gallon.

By the Numbers

E85 Fuel Cost:	$1.30/gal wholesale ($0.90/gal with tax credit), $1.63/gal on a gasoline-gallon-equivalent (gge) basis ($1.12/gal with tax credit)
Fuel Tank Capacity:	18 gallons (1996 Ford Taurus)
Fuel Economy:	23.1 miles per gallon of E85 (1995 Ford Taurus)
Range on E85:	410 miles (1996 Ford Taurus)

A federal "blender's income tax credit" of about $0.45 per gallon is available to anyone who mixes ethanol with gasoline for transportation fuel, such as a refiner or a pipeline company. Roelofs says this credit is available to most of the suppliers who furnish E85 to the state and the four municipal governments that maintain E85 fueling stations. "Most of the E85 suppliers we have talked to are willing to negotiate and pass the 'majority' of the credit on to the customers," says Roelofs. However, he believes that the market will make the final decision about how much of this savings is actually passed on to the customer. Minnesota is meeting with suppliers and municipal governments to discuss ways in which the tax credit could be used so that it not only increases suppliers' profits but also drops the price of E85 by about $0.40 per gallon.

Roelofs also pointed out an inequity in the federal tax code. When ethanol is blended with gasoline at levels of no more than 10%, a federal motor fuel excise tax credit of $0.054/gallon is available; however, this credit cannot be applied to blends with higher ethanol concentrations, such as the 85% ethanol in E85 fuel.

"E85 is more expensive than gasoline," Roelofs says. "But if you use the [blender's income] tax credit, and the cost of corn isn't sky high, you can start getting close to the cost of premium gasoline. The cost of E85 must become competitive with the cost of gasoline in order for E85 vehicles to be a viable option."

E85 Economics – Incremental Costs per Mile

Vehicle Price

Low Estimate $\left(\frac{\text{-\$400 cost incentive}}{\text{FFV}}\right)\left(\frac{\text{FFV}}{\text{75,000 miles}}\right)$ = **-$0.0053/mile**

High Estimate $\left(\frac{\text{\$500 penalty}}{\text{FFV}}\right)\left(\frac{\text{FFV}}{\text{75,000 miles}}\right)$ = **$0.0067/mile**

Special Synthetic Oil Cost

Low Estimate $\left(\frac{\text{-\$2.20 - \$0.65}}{\text{quart}}\right)\left(\frac{\text{5 quarts}}{\text{oil change}}\right)\left(\frac{\text{oil change}}{\text{3,000 miles}}\right)$ = **$0.0026/mile**

High Estimate $\left(\frac{\text{\$9.00 – \$0.65}}{\text{quart}}\right)\left(\frac{\text{5 quarts}}{\text{oil change}}\right)\left(\frac{\text{oil change}}{\text{3,000 miles}}\right)$ = **$0.0139/mile**

Special Fuel Filter Cost

$\left(\frac{\text{\$10.00 extra}}{\text{fuel filter}}\right)\left(\frac{\text{fuel filter}}{\text{20,000 miles}}\right)$ = **$0.0005/mile**

E85 Fuel Cost

High Estimate (retail price, no tax credit applied)

$\left[\left(\frac{\text{\$1.30}}{\text{gallon E85}}\right)\left(\frac{\text{gallon E85}}{\text{23.1 miles}}\right)\right] - \left[\left(\frac{\text{\$0.95}}{\text{gallon gas}}\right)\left(\frac{\text{gallon gas}}{\textit{(1.2)(23.1 miles)}}\right)\right]$ = **$0.0220/mile**

Mid Estimate (blender's income tax credit applied)

$\left[\left(\frac{\text{\$0.900}}{\text{gallon E85}}\right)\left(\frac{\text{gallon E85}}{\text{23.1 miles}}\right)\right] - \left[\left(\frac{\text{\$0.95}}{\text{gallon gas}}\right)\left(\frac{\text{gallon gas}}{\textit{(1.2)(23.1 miles)}}\right)\right]$ = **$0.0047/mile**

Low Estimate (blender's income tax credit and federal motor fuel excise tax credit applied)

$\left[\left(\frac{\text{\$0.85}}{\text{gallon E85}}\right)\left(\frac{\text{gallon E85}}{\text{23.1 miles}}\right)\right] - \left[\left(\frac{\text{\$0.95}}{\text{gallon gas}}\right)\left(\frac{\text{gallon gas}}{\textit{(1.2)(23.1 miles)}}\right)\right]$ = **$0.0025/mile**

Slow and Cautious

"I think we've taken a slow and fairly cautious approach [to using AFVs]," Roelofs says. "Our experience shows that there are definite niches for the different types of vehicles. Trying to put any given alternative fuel in a niche where it doesn't belong can be a disaster. But if you find the [right] niches, you can operate alternative-fuel vehicles as well as, or in some cases better than, traditional gasoline vehicles. We're going to continue to promote them, and we look for them to expand their coverage." Flexible-fuel ethanol vehicles were the right choice for Minnesota; they have proven cost-effective in this "random motor pool" of vehicles whose use varies according to driver needs.

Minnesota hopes to have 150,000 light-duty AFVs on the road by 2005. According to Roelofs, if the state can achieve this goal, approximately 5% of the gasoline currently used could be displaced by alternative fuels. This, in turn, will help Minnesota contribute to the U.S. Department of Energy's national goal of 10% displacement of gasoline by 2000.

Roelofs advises fleet owners who are considering AFVs: "If the application doesn't look like it's going to fit, don't push. If someone tries AFVs and is disappointed, that is a setback. The vehicle choices and fuel availability are not yet in place for every situation, so sometimes it's better to wait until there are more choices and the fueling infrastructure is more developed."

"The basic performance of the E85 FFV is there," Roelofs concluded. "We're very positive about AFVs. We look at this as one of the major focuses of our department for the next several years."

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Other Alternative Fuels in the Minnesota State Fleet

Although most of the AFVs in the state fleet are powered by ethanol, Minnesota is also trying other alternative fuels to determine performance and suitability for specific applications.

- The Minnesota Department of Transportation operates 11 dedicated propane-powered pickup trucks in the Minneapolis/St. Paul metropolitan area as part of its "Highway Helpers" motorist assistance program. The program has been very successful, and the DOT plans to buy more propane pickups.
- The University of Minnesota at Minneapolis operates three CNG sedans, two CNG vans, and one propane van. The university reports that the range of the CNG vehicle is somewhat limited, and refueling is inconvenient. The university is reluctant to expand its use of CNG vehicles at this time.

Ethanol Refueling Guidebook Available

A *Guidebook for Handling, Storing, and Dispensing Fuel Ethanol* has been published by the U.S. Department of Energy's Argonne National Laboratory. Subjects covered include fuel specifications, fuel handling, equipment recommendations, safety practices, and testing procedures. A copy of the document can be obtained through the National Alternative Fuels Hotline (800/423-1363).

Disclaimer

This case study is intended only to illustrate approaches that organizations could use in adopting AFVs in their fleets. The data cited here, although real experience for the fleet discussed in this case study, may not be replicated for other fleets. For more comprehensive information on the performance of AFVs and other related topics, please call (800/423-1363) or e-mail (hotline@afdc.nrel.gov) the National Alternative Fuels Hotline.

Published for the U.S. Department of Energy by Argonne National Laboratory 3/97

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